AIR QUALITY SURVEY
IN THE VICINITY OF THE
PETRO-CANADA TRAFALGAR REFINERY
OAKVILLE, ONTARIO

SEPTEMBER 1988

Environment Ontario

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Air Quality Survey in the vicinity of the Petro-Canada Trafalgar Refinery Oakville, Ontario

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EXECUTIVE SUMMARY

At the request of the Central Region, Mobile Air Monitoring Units #1 and #2 performed an air quality survey in the vicinity of the Petro-Canada (Trafalgar) Refinery in Oakville during August and September of 1987. The main aims of this survey were to: (1) monitor during periods of odour; (2) attempt to identify the compounds causing the odour(s); and (3) compare the results obtained with previous surveys in order to determine the extent of improvement in ground level concentrations of the measured contaminants (particularly total reduced sulphur compounds) after refinery modifications.

Sixty-three different monitoring periods comprised this survey with 79 volatile organic samples and over 500 hours of common contaminant data being collected.

From all of these data, none of the applicable Ministry Air Quality Standards, Criteria, Guidelines or Provisional Guidelines were exceeded for any of the measured gaseous contaminants.

During the late summers of 1984 and 1985, air quality surveys were conducted in this same area. This survey was also conducted during late summer and the comparison of data indicates that the air quality downwind of Petro-Canada has generally improved over the years (in particular the ambient concentrations of volatile organic compounds). However, odour may be still be a problem since significant concentrations of total reduced sulphur compounds and some specific organics were measured during the 1987 survey. When not monitoring downwind of Petro-Canada, the general air quality does appear to have remained essentially the same.

Abbreviations that will be used in this survey report:

CH_4	methane
CO	carbon monoxide
GC	gas chromatograph
i.e.	that is
km/hr	kilometres per hour
MAMU	Mobile Air Monitoring Unit
na.	not available
nd.	not detected
NO	nitric oxide
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
O_3	ozone
ppm	parts per million
SO_2	sulphur dioxide
THC	total hydrocarbon compounds
TH-M	non-methane hydrocarbons
TRS	total reduced sulphur compounds
ug/m^3	micrograms per cubic metre
VOC(s)	volatile organic compound(s)

1.0 Background and Introduction

Petro-Canada's Trafalgar refinery in Oakville occupies approximately one-third of a 120 hectare landscaped site on the west bank of Bronte Creek, south of the Queen Elizabeth Way (Figure 1). This refinery and its tank farm were built in 1958 and after successive expansions and modifications, can now refine in excess of 13,500 cubic metres per day of Canadian crude oil. As reported by the Regional Toronto Office of the Ministry of the Environment, the Trafalgar refinery was at full production during the survey (i.e. they were processing approximately 80,000 barrels of crude oil daily).

There is a history of odour complaints in this area. The Air Resources Branch undertook air quality surveys in 1984 (ARB-016-85-ARSP) and 1985 (ARB-069-86-AQM) to specifically address this problem. Since 1985, there have been several refinery modifications: including upgrading of the sour water stripper; reconstruction of #1 catalytic cracker; and a new 100 metre stack. As a result, the number of odour complaints have decreased but they are still prevalent.

Furthermore, residental and industrial development is planned for the areas immediately to the west of the plant (i.e. west of Burloak Drive and south of the Queen Elizabeth Way), to the south of the plant (i.e. south of Rebecca Street and between Burloak and Mississauga roads), and to the north of the plant (i.e. south of the South Service Road; between the Queen Elizabeth Way and the northern edge of Petro-Canada's property). Because of this pending development, the regional and town officals of Oakville requested a survey in 1987 in order to assess the air quality in these areas and in particular, determine the ambient concentrations of total reduced sulphur compounds, sulphur dioxide, and various hydrocarbons in comparison to the 1984 and 1985 surveys of the same plant.

2.0 The Monitoring Programme

The mobile air monitoring units (MAMU#1 and #2) used in this survey contained a variety of analyzers that enabled screening of the ambient air for 138 different volatile organic compounds (VOCs) and 10 common (mainly inorganic) contaminants (namely; sulphur dioxide (SO_2), oxides of nitrogen (NO_x), nitric oxide (NO), nitrogen dioxide (NO_2), total hydrocarbon compounds (THC), non-methane hydrocarbons (TH-M), methane (CH_4), total reduced sulphur compounds (TRS), ozone (O_3) and carbon monoxide (CO)).

The most versatile analyzer of each monitoring unit was the dual capillary column gas chromatographic system which was used for the detection, identification and quantification of VOCs. To detect individual VOCs at the 1 ug/m^3 concentration level, ambient air was drawn through a trace organic preconcentrator unit for a set period of time; usually for a half-hour or a one-hour duration. In the preconcentrator, the organics were adsorbed onto a Carbotrap-Spherocarb cartridge and then thermally desorbed and prefocused onto a nickel loop cooled to -195^{o}C with liquid nitrogen. The prefocused organics were then flash vapourized and injected simultaneously onto the heads of two 25 metre capillary columns (OV-1 and SE-54) where the individual organics were separated. The eluted organics were then detected by flame ionization detectors. Positive identification of the eluted volatile organic compounds was assisted by a computer which compared and correlated the results with a library of retention indices which were established from prior calibration tests.

Each MAMU also housed a complete ground-based meteorological station which continuously recorded wind direction and speed, ambient temperature, humidity, solar radiation and barometric pressure data.

A more detailed description of the specific monitoring capabilities of each monitoring unit is listed in Table 1 and the respective detection limits for the gaseous contaminants together with applicable Ministry of the Environment Standards, Criteria, Guidelines and Provisional Guidelines are presented in Table 2.

The daily monitoring programme consisted of performing calibration checks on all analyzers during the early morning; acquiring downwind air quality data with respect to Petro-Canada whenever feasible; and then acquiring upwind data. Usually, samples were collected for VOC analysis only when the operators felt that the monitoring units were downwind of Petro-Canada or when upwind data were required. At other times (overnight or when the units could not be positioned downwind), a limited VOC sampling programme was carried out.

As presented in Table 3, monitoring was conducted between

August 17 and September 3, 1987. During this time, a large data set was collected for the above-mentioned contaminants. In particular, MAMUs #1 and #2 acquired 42 VOC samples and almost 56 hours of common contaminant data during 20 different monitoring periods **downwind** of Petro-Canada; 23 VOC samples and almost 30 hours of common contaminant data during 15 different monitoring periods **upwind** of Petro-Canada; and 14 VOC samples and 423 hours of common contaminant data during 28 monitoring periods for **general air quality** characterization (including overnight monitoring) (Table 4).

A number of good roads surrounded the Petro-Canada Trafalgar refinery and if there was any wind, concurrent downwind and upwind monitoring was usually possible. In addition, four semi-permanent sites for overnight monitoring were also established: one located to the north of the refinery (on the South Service Road); one to the southwest (at the corner of Burloak and Rebecca); and two to the eastsoutheast (at the corner of Bronte and Speers and at St. Dominic's Church and School on Rebecca).

3.0 Discussion of Results

3.0.1 Downwind Monitoring

As mentioned earlier, 42 VOC samples and almost 56 hours of common contaminant data were acquired downwind of Petro-Canada (Table 4).

From the common contaminant data acquired downwind of this plant (Tables 5, 6 and 7), none of the applicable Ministry of the Environment Air Quality Criteria or Standards were exceeded. The maximum half-hour average ground level concentrations of CO, TRS, SO_2, NO_2 and TH-M were 7.0, 0.016, 0.05, 0.04, and 5.6 ppm respectively. (Please note that the 1-hour Criterion for CO is 30 ppm. The measured maximum half-hour average ground level concentration of CO was 7 ppm, thus the Criterion was not exceeded.)

A strong rotten-egg type odour was detected on several occasions by the Ministry staff while the monitoring units were downwind of Petro-Canada. This type of odour was reflected by the significant concentrations of TRS measured in the air. Total reduced sulphur compounds may contain any or all of the following: hydrogen sulphide, methyl mercaptan, dimethyly sulphide, dimethyl disulphide, carbonyl sulphide and several other malodourous compounds. These compounds have different odour thresholds ranging from less than one part per billion to several parts per million. The Ministry developed a TRS Air Quality Standard specifically for the kraft pulp mill environment and its value for a maximum acceptable half-hour average ground level concentration at the point of impingement is 0.027 ppm.

The maximum half-hour average concentration of TRS measured during this survey was 0.016 ppm (Tables 5 and 7). This value was recorded during the afternoon of August 19 when MAMU#1 was on Rebecca Street, approximately 100 metres west of Mississauga Street and directly downwind of Petro-Canada's heavy oil terminal (monitoring period A192). The ambient temperature was approximately 28°C (degrees Celsius) and the winds were from the westnorthwest at about 30 km/hr. At times, the rotten-egg type odour was very strong and although not shown in the data tables, the maximum one-minute average concentration of TRS measured downwind was 0.303 ppm. For the other common contaminants, the maximum half-hour average concentrations were 2.1 ppm for CO; 1.4 ppm for TH-M; and 0.02 ppm for NO_2 (Table 5). After 17:00 hrs, MAMU#1 moved upwind to the corner of Rebecca and Burloack Drive where it was prepared for overnight monitoring (A193). The concentrations of CO and TH-M had diminished slightly and no TRS was detected (i.e. if TRS compounds did exist in the ambient air, they were at concentrations less than 0.002 ppm; the detection limit of the analyzer) (Table 5).

On September 9, significant ground level concentrations of CO, TH-M and NO_x were again measured (monitoring period A033).

MAMU#1 was at the semi-permanent site on the South Service Road and the winds were southeasterly at 15 to 20 km/hr. Although the site was downwind of Petro-Canada, the Ministry staff deemed that the most plausible source was vehicular emissions. The maximum half-hour average concentrations for CO and TH-M were 7.0 and 5.6 ppm respectively and although not specifically shown, 0.04 ppm for SO_2 and 0.18 ppm for NO_x (Tables 5 and 7).

From analyses of the 42 VOC samples acquired downwind of Petro-Canada, 46 different organic compounds were detected (Tables 4 and 8). The average total organic concentration was 156 ug/m^3 with the alkane fraction comprising 72% (113 ug/m^3) of this total and the aromatic fraction 21% (33 ug/m^3). The more dominant VOCs were the low-boiling alkanes (propane through hexane), benzene, toluene and xylenes but the individual average concentrations were all less than 30 ug/m^3.

During the 1984 and 1985 air quality surveys, the maximum total organic concentrations were 7,010 and 1,197 ug/m^3 respectively. In 1987, the maximum was 706 ug/m^3.

The most dominant VOC detected downwind of Petro-Canada in 1987 was benzene and its maximum half-hour average concentration was 234 ug/m^3. The sample was acquired at St. Dominic's School during the afternoon of August 25 (B253). The Ministry's benzene Air Quality Standard is currently under review but at time of writing was set at 10,000 ug/m^3. In 1985, the maximum benzene concentration was 100 ug/m^3.

In addition to benzene, special emphasis was placed on determining the ambient concentrations of the following organics during the 1985 survey: dichloromethane; trichloromethane (chloroform); 1,2-dichloroethane; 1,1,2-trichloroethane; tetrachloromethane; trichloroethene; 1,1,2,2-tetrachloroethane; and styrene. In 1985, the maximum concentration of all the chlorinated organics detected downwind of Petro-Canada was only 7 ug/m^3. In 1987, no chlorinated organics nor styrene were detected in any of the downwind samples (Table 8). Or in other words, if any of these VOCs were present in the ambient air, they were at concentrations less than the minimal detection limits set by the field gas chromatographic systems (Table 2).

In 1984, the dominant organics were xylenes, 1,2,4-trimethybenzene, and 2-methylbutane and their maximum concentrations were 1500, 250 and 395 ug/m^3 respectively. In 1985, these maxima were 17, 10 and 202 ug/m^3 respectively and in 1987, they were 11, 3 and 140 ug/m^3 respectively.

3.0.2 Upwind Monitoring

Twenty-three VOC samples and almost 30 hours of common contaminant data were acquired upwind of Petro-Canada. Concurrant with 8 of the 15 upwind monitoring periods, downwind monitoring was also carried out (Table 4).

From the acquired downwind data, the measured ground level concentrations of the detected contaminants were relatively low and none of the applicable Ministry Air Quality Standards, Criteria, Guidelines or Provisional Guidelines were exceeded (Table 2).

For the common contaminants, the maximum half-hour average concentrations of CO, TRS, SO_2, NO_2, and TH-M were 5.5, 0.004, 0.01, 0.08 and 1.6 ppm respectively (Table 7).

When the half-hour average concentration of 5.5 ppm for CO was measured, MAMU#1 was at Sherwood Park, west of and upwind of Petro-Canada (Figure 1). The monitoring was conducted during the afternoon of August 17 (A173) and 1.4 hours of common contaminant data were acquired. The winds were westerly at 40 km/hr and the maximum half-hour average concentrations of the other contaminants, namely TH-M, TRS and NO_2 were 0.4, 0.004, and 0.02 ppm respectively (Table 5). No VOC sampling was undertaken and the most plauable source of CO was deemed to be emissions from vehicular traffic along the Queen Elizabeth Way.

From the analyses of the 23 VOC samples, a maximum of 49 different organics were detected. The average total organic concentration was 119 ug/m^3 and this was composed of approximately 64% alkanes (76 ug/m^3) and 26% aromatics (31 ug/m^3) (Table 8). The average component analysis of the upwind samples was almost identical to that of the downwind samples with only minor differences being noticed in the alkanes and chlorinated alkanes. For the downwind samples, the average alkane concentration was 113 ug/m^3 whereas for the upwind samples, the average alkane concentration was 76 ug/m^3. No chlorinated organics were detected downwind but dichloromethane (a maximum of 4 ug/m^3), trichloromethane (11 ug/m^3), tetrachloromethane (26 ug/m^3) and 1,1,1-trichloroethane (6 ug/m^3) were detected in the upwind samples. These chlorinated organic concentrations were near the detection limits of the field gas chromatographic systems and are well below any of the applicable Ministry Air Quality Standards, Criteria, Guidelines or Provisional Guidelines (Table 2).

The more dominant organics detected in the upwind samples were the low-boiling alkanes (propane through hexane) with average concentrations less than 20 ug/m^3 and benzene, toluene and xylenes with average concentrations of 14, 10, and 8 ug/m^3 respectively. From analyses of the individual samples, the major organics were butane (119 ug/m^3), 2-methylbutane (78 ug/m^3), pentane (57 ug/m^3) and benzene (63 ug/m^3).

In 1985, the total organic concentrations detected upwind of Petro-Canada ranged from 19 to 242 ug/m^3 for a mean of 73 ug/m^3. The alkane average concentration was 38 ug/m^3 and the aromatics, 26 ug/m^3. With respect to the common contaminants, the maximum half-hour average concentrations were 3.6 ppm for CO; 0.006 ppm for TRS; 0.005 ppm for SO_2; 1.1 ppm for TH-M; and 0.16 ppm for NO_2.

From these results, the air quality data acquired upwind of Petro-Canada in 1987 appears to be very similar to the data obtained in 1985.

3.0.3 General Air Quality

When atmospheric dispersion conditions were poor; when source(s) emissions could not be distinguished; or when night-time monitoring was undertaken, the air quality data acquired by the monitoring units were treated as general air quality data. Monitoring under these conditions was conducted during 28 different monitoring periods with almost 423 hours of common contaminant data and 14 VOC samples being acquired (Table 4).

From this monitoring, the ground level concentrations of the detected contaminants were low and none of the applicable Ministry Air Quality Standards, Criteria, Guidelines or Provisional Guidelines were exceeded (Tables 2, 7 and 8).

For the common contaminants, the maximum one-hour average concentrations of CO, TRS, SO_2, NO_2, and TH-M were 4.3, 0.006, 0.03, 0.07, and 5 ppm respectively. The overall average concentrations of these same contaminants (based on the 423 hours of data) were 0.6, 0.002, 0.01, 0.03 and 0.6 ppm respectively (Table 7).

When MAMU#2 measured 4.3 ppm of CO, it was at the corner of Bronte and Speers Road (B013) and the winds were southwesterly and very light. Overnight monitoring had commenced at 20:08 hrs on September 1 and this elevated concentration was measured between 07:00 and 08:00 hrs on September 2. Although not shown, no TRS was detected at this time and the one-hour average concentrations of the other common contaminants, namely; TH-M, NO_2, and NO were 1.8, 0.05, and 0.14 ppm respectively. Although no VOC sampling was carried out, the most plausible source of these contaminants was thought to be emissions from the morning rush-hour traffic along Bronte and Speers roads.

When MAMU#2 measured 5 ppm of TH-M, it was at St. Dominic's School on Rebecca Street (B243). An overnight monitoring programme was started at 17:41 hrs on August 24 and the elevated concentrations of TH-M were measured between 02:00 and 03:00 hrs on August 25. Although not shown in the data tables, the one-hour average concentrations of CO, TRS, SO_2, NO_2, and NO were 0.4, 0.005, 0.03, 0.4 and less than 0.01 ppm respectively. During this time, the winds were southwesterly and very light (Tables 3 and 6). No discrete source(s) of the non-methane hydrocarbons could be determined and the elevated concentrations were thought to have resulted as a normal and gradual buildup of pollution in the area due to poor atmospheric dispersion conditions associated with a weak nocturnal inversion. The continuous measurements of the meteorological parameters and the common contaminants throughout the night support this hypothesis. (It is worthwhile to note that the Ministry has no Air Quality Standard, Criterion, Guideline or Provisional Guideline for non-methane hydrocarbons or total hydrocarbons.)

From the analyses of the 14 VOC samples, 43 different

organic compounds were detected. The average total organic concentration was 195 ug/m^3 with the alkanes accounting for approximately 73% (143 ug/m^3) of this total, the aromatics 6% (11 ug/m^3) and the alkenes 19% (37 ug/m^3) (Table 8). These figures are somewhat misleading since 4 of the 14 samples had total organic concentrations of 700, 924, 326 and 329 ug/m^3. Two of these samples were acquired between 18:24 and 19:57 hrs on August 18 (B183) and the other 2 were acquired between 17:15 and 18:54 hrs on August 20 (A203). If these results were removed from the data set, the average total organic concentration determined from the remaining 10 samples would only be 45 ug/m^3. In 1984 and 1985, the average total organic concentrations were 47 and 73 ug/m^3.

On August 18, MAMU#2 was at St. Dominic's School on Rebecca Street and an overnight monitoring programme was carried out (Table 3; B183). During the VOC sampling (i.e. between 18:00 and 20:00 hrs), the winds were from the southwest at 10 to 15 km/hr and as a result, this site was downwind of the Petro-Canada refinery. Higher than usual concentrations of butane (146 ug/m^3), 2-methylbutane (239 ug/m^3), 2-methyl-1-butene (409 ug/m^3) and pentane (204 ug/m^3) were detected. Although these concentrations may seem to be elevated, they are not considered to be significant. The Ministry has no applicable Air Quality Standards, Criteria, Guidelines, or Provisional Guidelines for these organics: i.e. for butane, 2-methylbutane, 2-methyl-1-butene or pentane (Table 2). Furthermore, low concentrations of the common contaminants were also measured at this time as the maximum one-hour average concentrations for CO, TH-M, TRS and NO_2 were only 0.5, 1.1, less than 0.002, and 0.04 ppm respectively (Table 6).

On August 20, MAMU#1 was at the west end of the Petro-Canada Skidpad at the corner of Wyatt Street and Bronte Road. Monitoring commenced at 16:59 hrs and the winds were northwesterly at 10 km/hr (Tables 3 and 5; A203). Two half-hour VOC samples were acquired during this time and the total organic concentrations were determined to be 326 and 329 ug/m^3. The alkane component dominated with concentrations of 312 and 315 ug/m^3 (or over 95% of the total organic concentrations). Although not shown in the appendix, the more dominant organics were propane (208 ug/m^3), 2-methylpropane (36 ug/m^3), butane (62 ug/m^3), 2-methylbutane (44 ug/m^3), and pentane (19 ug/m^3). It should be reiterated that although these VOC concentrations were higher than normal, they were still not considered to be significant. The common contaminant monitoring lasted for just over 2 hours and low concentrations were measured as the maximum half-hour average concentrations of CO, TH-M, TRS, and NO_2 were 0.8, 1.5, less than 0.002, and 0.01 ppm respectively. The field staff observed that the winds were from the northwest (a 'crosswind' with respect to Petro-Canada; Figure 1) and as a result, the monitoring unit was neither upwind nor downwind of Petro-Canada.

When compared with the overall average concentrations measured during the previous surveys in 1984 and 1985, the general air quality has essentially remained the same in this area of Oakville.

4.0 Summary

At the request of the Central Region, Mobile Air Monitoring Units #1 and #2 performed an air quality survey in the vicinity of the Petro-Canada (Trafalgar) oil refinery in Oakville during August and September of 1987. The main aims of this survey were to: (1) monitor during periods of odour; (2) attempt to identify the compounds causing the odour(s); and (3) to compare the results obtained with previous surveys in order to determine the extent of improvement in ground level concentrations of the measured contaminants (particularly TRS) after refinery modifications.

This survey was conducted from August 17 to September 3 and during this time, air quality data were acquired during 63 different monitoring periods with 79 volatile organic samples and almost 510 hours of common contaminant data being collected.

From all of the data acquired during this survey, none of the applicable Ministry Air Quality Standards, Criteria, Guidelines or Provisional Guidelines were exceeded for the measured gaseous contaminants.

During this survey, the maximum half-hour average ground level concentration of total reduced sulphur compounds measured downwind of the Petro-Canada refinery was 0.016 ppm (parts per million); for sulphur dioxide, 0.05 ppm; for carbon monoxide, 7.0 ppm; for nitrogen dioxide, 0.08 ppm; and for nonmethane hydrocarbons, 5.6 ppm. From the upwind measurements, these maxima were 0.004, 0.01, 5.5, 0.08 and 1.6 ppm respectively.

Up to 46 different organics were detected in the 42 volatile organic compound (VOC) samples acquired downwind of Petro-Canada and the average total concentration was 156 ug/m^3 (micrograms per cubic metre); for upwind sampling, up to 49 different organics were detected and the average was 119 ug/m^3. The maximum total organic concentration detected downwind was 706 ug/m^3 and the maximum upwind total concentration was 476 ug/m^3.

From analyses of all the VOC samples (i.e. those acquired downwind, upwind and the general air quality measurements), the major organics were propane, 2-methylpropane, butane, 2-methylbutane, 2-methyl-1-butene, pentane and benzene with maximum concentrations of 208, 80, 163, 239, 409, 204 and 234 ug/m^3 respectively.

The Ministry staff did perceive some odour during this survey. The odour may have been some reduced sulphur compound or perhaps some volatile organic. A rotten-egg or waste odour is characteristic of reduced sulphur compounds which may include any or all of the following: hydrogen sulphide, methyl mercaptan, dimethyly sulphide, dimethyl disulphide, carbonyl sulphide and several other malodourous compounds. They all have different odour thresholds ranging from less than one part per billion to several parts per

million. Although a maximum half-hour average concentration of 0.016 ppm was measured for these compounds, the Ministry has no Air Quality Standard applicable to an oil refinery. Of the organics, benzene and 2-methyl-1-butene may have been the cause of some of the odour. Benzene has a sweet aromatic odour and 2-methyl-1-butene has a somewhat disagreeable, sweet acrid odour. Although the maximum half-hour average concentrations for these organics were elevated (234 ug/m^3 for benzene and 409 ug/m^3 for 2-methyl-1-butene), the odour threshold for benzene is approximately 130 ug/m^3 but nothing has been established for 2-methyl-1-butene. If these maximum half-hour concentrations were based on short term exposure concentrations (say for several seconds), the levels would have been much higher and some noticeable odour may have resulted.

Contaminant Concentrations Measured **Downwind** of Petro-Canada

VOCs - ug/m^3 Common Contaminants - ppm

Maximum Half-Hour Average Concentrations

Contaminant	1984	1985	1987
TRS	0.015	0.063	0.016
SO_2	0.14	0.07	0.05
NO_2	0.07	0.14	0.04
CO	28.6	5.1	7.0
TH-M	40.7	1.5	5.6
Total Organic Conc.	7010	1197	706
Alkanes	3702	1071	602
Aromatics	2694	155	33
Chlorinated Organics	266	7	nd.
Number of VOC Samples	15	47	42

Overall Average Concentrations - General Air Quality

Contaminant	1984	1985	1987
TRS	na.	0.002	0.002
SO_2	0.01	0.01	0.01
NO_2	0.01	0.05	0.03
CO	0.7	0.8	0.6
TH-M	1.0	0.3	0.6
Total Organic Conc.	47	73	195
Alkanes	25	38	143
Aromatics	18	26	11
Chlorinated Organics	1	7	2
Number of VOC Samples	6	19	14

The above is a comparison between the 1987 data set and those acquired in 1984 and 1985 when similar air quality surveys

were conducted. The 1984 data was taken from Report ARB-16-85-AR/SP and the 1985 data was from ARB-69-86-AQM. Both of these reports are available from the Air Resources Branch.

All three surveys were conducted during the late summer and generally, the air quality downwind of Petro-Canada appears to have improved over the years (in particular the ambient concentrations of volatile organic compounds). However, odour may be still be a problem since significant concentrations of TRS and some specific organics were still being measured downwind in 1987. Elsewhere, the general air quality appears to have remained essentially the same over the years.

APPENDIX ..... The Data

Figure 1

General Area Map - Oakville '87

Table 1

THE INSTRUMENTATION OF MOBILE AIR MONITORING UNIT #1

Instrument[1]	Manufacturer	Analytical Technique	Full Scale Sensitivity
THC, CH4, TH-M analyzer	Ingenieur-Produktions-Gruppe Munchen (IPM) RS-t	Dual flame ionization	50 ppm THC (as CH4)
H2S,SO2,NOx sources	Hartmann & Braun Prufgasgenerator	-	-
TRS/SO2 analyzer	Monitor Labs 8850 c/w ML 8770	Fluorescence	0.5 ppm SO2 0.5 ppm TRS
NOx, NO2, NO analyzer	Monitor Labs 8840	Chemi-Luminescence	1.0 ppm NOx (as NO2)
CO analyzer	Thermo Electron P48	Gas Filter Correlation	100 ppm CO (digital)
O3 analyzer/ source	Dasibi 1003-AAS	UV Absorption	1.0 ppm O3 (digital)
Hewlett Packard Data Acquisition System - HP 85 and HP 3497A			
Gas Chromatograph	HP 5880 Dual Capillary Column c/w HP 86 Data Acquisition System	Flame Ionization Det.	as set per calibrations

Meteorological Instrumentation

Instrument	Manufacturer	Scale
Wind speed **	Lambrecht GmBH	km/hr
Wind direction **	Lambrecht GmBH	degrees
Temperature	Weather Measure (WM) T621	degrees Celsius
Humidity	WM-HM-11P	% relative
Barometric pressure	WM-BM70-B242	millibars
Solar Radiation	WM Star Pyranometer	milliwatts/cm2

** These instruments are located on top of a 10 metre retractable tower

[1] Sources are used for daily calibration of the instruments.

Table 1 ctd.

THE INSTRUMENTATION OF MOBILE AIR MONITORING UNIT #2

Instrument[1]	Manufacturer	Analytical Technique	Full Scale Sensitivity
THC, CH4, TH-M analyzer	Ingenieur-Produktions-Gruppe Munchen (IPM) RS-t	Dual flame ionization	50 ppm THC (as CH4)
H2S,SO2,NOx sources	Hartmann & Braun Prufgasgenerator	-	-
TRS analyzer	Monitor Labs 8850 c/w ML 8770	Fluorescence	0.5 ppm H2S
SO2 analyzer	Monitor Labs 8850	Fluorescence	0.5 ppm SO2
NOx, NO2, NO analyzer	Monitor Labs 8840	Chemi-Luminescence	1.0 ppm NOx (as NO2)
CO analyzer	Thermo Electron P48	Gas Filter Correlation	100 ppm CO (digital)
O3 analyzer/ source	Dasibi 1003-AAS	UV Absorption	1.0 ppm O3 (digital)
Hg analyzer	Scintrex HGP-2	UV Absorption	50 ug/m3
Hewlett Packard Data Acquisition System - HP 85 and HP 3497A			
Gas Chromatograph	HP 5880 Dual Capillary Column c/w HP 86 Data Acquisition System	Flame Ion-ization Det.	as set per calibrations

Meteorological Instrumentation

Instrument	Manufacturer	Scale
Wind speed **	Lambrecht GmBH	km/hr
Wind direction **	Lambrecht GmBH	degrees
Temperature	Weather Measure (WM) T621	degrees Celsius
Humidity	WM-HM-11P	% relative
Barometric pressure	WM-BM70-B242	millibars
Solar Radiation	WM Star Pyranometer	milliwatts/cm2

** These instruments are located on top of a 10 metre retractable tower

[1] Sources are used for daily calibration of the instruments.

Table 2

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m^3 (micrograms per cubic metre) Updated October 16, 1987

	Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
1 PROPANE	0.2					
2 PROPADIENE	0.3					ALLENE
3 PROPYNE	0.3					*METHYL ACETYLENE*
4 CYCLOPROPANE	0.3					
5 2-METHYLPROPANE	0.3					ISOBUTANE
6 CHLOROETHENE	0.3	560 (2)	280 (A)	5000	10000	VINYL CHLORIDE; CHLOROETHYLENE
7 1-BUTENE	0.3					
8 1,3-BUTADIENE	0.3					
9 BUTANE	0.2			1900000		*n-BUTANE*
10 1-BUTYNE	0.3					ETHYLACETYLENE
11 CHLOROETHANE	0.3			2600000	3250000	ETHYL CHLORIDE
12 3-METHYL-1-BUTENE	0.3					ISOAMYLENE
13 2-METHYLBUTANE	0.3					ISOPENTANE
14 2-METHYL-1-BUTENE	0.3					
15 PENTANE	0.2			1800000	2250000	*N-PENTANE*
16 2-METHYL-1,3-BUTADIENE	0.4					ISOPRENE
17 trans-2-PENTENE	0.2					
18 cis-2-PENTENE	0.2					
19 DICHLOROMETHANE	1.5	100000 (1)	100000 (B)	350000	1740000	METHYLENE CHLORIDE
20 2-METHYL-2-BUTENE	0.3					
21 2,2-DIMETHYLBUTANE	0.2					NEOHEXANE

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m³ (micrograms per cubic metre) Updated October 16, 1987

	Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
22 trans-1,2-DICHLOROETHENE	0.3					
23 3-METHYL-1-PENTENE	0.2					
24 4-METHYL-1-PENTENE	0.2					
25 CYCLOPENTANE	0.2					
26 2,3-DIMETHYLBUTANE	0.2					
27 2-METHYLPENTANE	0.2					
28 3-METHYLPENTANE	0.2					
29 1-HEXENE	0.3					
30 cis-1,2-DICHLOROETHENE	0.3			790000	1000000	cis-1,2-DICHLOROETHYLENE; SYM-DICHLOROETHYLENE
31 2-CHLOROBUTANE	0.6					sec-BUTYL CHLORIDE
32 1-CHLORO-2-METHYLPROPANE	0.4					
33 HEXANE	0.3	35000 (2)	12000 (A)	180000		*n-HEXANE*
34 TRICHLOROMETHANE	2.2	1500 (2)	500 (A)	50000	225000	CHLOROFORM
35 trans-3-HEXENE	0.3					
36 3-CHLORO-2-METHYLPROPENE	0.3					ISOBUTENYL CHLORIDE
37 METHYLCYCLOPENTANE	0.2					
38 2,4-DIMETHYLPENTANE	0.2					
39 1,2-DICHLOROETHANE	0.2			40000	60000	ETHYLENE CHLORIDE
40 2,2-DIMETHYLPENTANE	0.4					
41 2,2,3-TRIMETHYLBUTANE	0.2					
42 1,1,1-TRICHLOROETHANE	1.0	350000 (1)	115000 (A)	19000000	2450000	METHYL CHLOROFORM

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m³ (micrograms per cubic metre) Updated October 16, 1987

	Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
43 1-CHLOROBUTANE	0.4					n-BUTYL CHLORIDE
44 BENZENE	0.2	10000 (1)	3300 (A)	30000	75000	
45 TETRACHLOROMETHANE	0.9	1800 (2)	600 (A)	20000	125000	CARBON TETRACHLORIDE
46 3,3-DIMETHYLPENTANE	0.2					
47 CYCLOHEXANE	0.2	300000 (2)	100000 (A)	1050000	1300000	HEXAHYDROBENZENE
48 2,3-DIMETHYLPENTANE	0.3					
49 2-METHYLHEXANE	0.5					ISOHEPTANE
50 CYCLOHEXENE	0.3			1015000		
51 DIBROMOMETHANE	18.4					METHYLENE DIBROMIDE; METHYLENE BROMIDE
52 1,2-DICHLOROPROPANE	0.6					PROPYLENE CHLORIDE
53 3-METHYLHEXANE	0.5					
54 2,3-DICHLOROPROPENE	0.7			5000	50000	2,3-DICHLOROPROPYLENE
55 TRICHLOROETHENE	0.3	85000 (1)	28000 (A)	270000	1080000	TRICHLOROETHYLENE
56 2,2,4-TRIMETHYLPENTANE	0.2					ISOOCTANE
57 1-HEPTENE	0.3					
58 HEPTANE	0.2			1600000	2000000	*n-HEPTANE*
59 trans-2-HEPTENE	0.3					
60 METHYLCYCLOHEXANE	0.2			1600000	2000000	HEXAHYDROTOLUENE
61 2,2-DIMETHYLHEXANE	0.2					
62 ETHYLCYCLOPENTANE	0.2					
63 4-METHYLCYCLOHEXENE	0.3					

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m³ (micrograms per cubic metre) Updated October 16, 1987

	Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
64 2,5-DIMETHYLHEXANE	0.5					
65 1-CHLOROPENTANE	0.4					n-AMYL CHLORIDE; PENTYL CHLORIDE
66 1,1,2-TRICHLOROETHANE	1.1					VINYL TRICHLORIDE
67 2,3,4-TRIMETHYLPENTANE	0.2					
68 TOLUENE	0.2	2000 (1)	2000 (A)	375000	560000	*METHYLBENZENE*; PHENYLMETHANE
69 1,3-DICHLOROPROPANE	0.7			350000	510000	TRIMETHYLENE CHLORIDE
70 2-METHYLHEPTANE	0.2					
71 4-METHYLHEPTANE	0.2					
72 c-1,3-DIMETHYLCYCLOHEXANE	0.2					
73 3-METHYLHEPTANE	0.2					
74 1,2-DIBROMOETHANE	2.1					ETHYLENE DIBROMIDE; ETHYLENE BROMIDE
75 1,1-DIMETHYLCYCLOHEXANE	0.3					
76 1-OCTENE	0.4	150000 (3)	50000 (A)			
77 trans12DIMETHYLCYCLOHEXANE	0.3					*trans-1,2-DIMETHYLCYCLOHEXANE
78 trans-4-OCTENE	0.3					
79 TETRACHLOROETHENE	0.9	10000 (2)	4000 (A)	335000	1340000	TETRACHLOROETHYLENE; PERCHLOROETHYLENE
80 c-1,4-DIMETHYLCYCLOHEXANE	0.3					
81 OCTANE	0.3	45400 (3)	15300 (A)	1450000	1800000	*n-OCTANE*
82 trans-2-OCTENE	0.6					
83 cis12DIMETHYLCYCLOHEXANE	0.2					
84 CHLOROBENZENE	0.4			350000		PHENYL CHLORIDE

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m³ (micrograms per cubic metre) Updated October 16, 1987

		Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
85	ETHYLCYCLOHEXANE	0.1					
86	1-CHLOROHEXANE	0.5					n-HEXYL CHLORIDE
87	ETHYLBENZENE	0.3	4000 (1)	4000 (B)	435000	545000	
88	m&p-XYLENES	0.3	2300 (4)	2300 (A)	435000	655000	*1,3-DIMETHYLBENZENE*
89	4-METHYLOCTANE	0.3					
90	2-METHYLOCTANE	0.3					
91	3-METHYLOCTANE	0.3					
92	STYRENE	0.5	400 (1)	400 (A)	215000	425000	*ETHENYLBENZENE*; PHENYLETHYLENE; VINYLBENZENE
93	1,4-DICHLOROBUTANE	0.3					
94	o-XYLENE	0.3	2300 (4)	2300 (A)	435000	655000	*1,2-DIMETHYLBENZENE*
95	1,1,2,2-TETRACHLOROETHANE	2.6					ACETYLENE TETRACHLORIDE
96	1,2,3-TRICHLOROPROPANE	1.3			300000	450000	TRICHLOROHYDRIN
97	1-NONENE	0.7					
98	trans-1,4-DICL-2-BUTENE	0.9					
99	NONANE	0.3			1050000	1300000	*n-NONANE*
100	ISOPROPYLBENZENE	0.3	100 (3)	100 (B)			*(1-METHYLETHYL)BENZENE*; CUMENE
101	2-CHLOROTOLUENE	0.3					*2-CHLORO-1-METHYLBENZENE*; o-TOLYL CHLORIDE; o-CHLOROTOLUENE
102	3-CHLOROTOLUENE	0.5					*3-CHLORO-1-METHYLBENZENE*; m-TOLYL CHLORIDE; m-CHLOROTOLUENE
103	4-CHLOROTOLUENE	0.5					*4-CHLORO-1-METHYLBENZENE; p-TOLYL CHLORIDE; p-CHLOROTOLUENE
104	PROPYLBENZENE	0.4					n-PROPYLBENZENE
105	3-ETHYLTOLUENE	0.3					*1-ETHYL-3-METHYLBENZENE*; M-ETHYLTOLUENE

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m^3 (micrograms per cubic metre) Updated October 16, 1987

		Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
106	4-ETHYLTOLUENE	0.3					*1-ETHYL-4-METHYLBENZENE*; P-ETHYLTOLUENE
107	1,3,5-TRIMETHYLBENZENE	0.4			125000	170000	MESITYLENE
108	2-ETHYLTOLUENE	0.3					*1-ETHYL-2-METHYLBENZENE*; O-ETHYLTOLUENE
109	1,2,4-TRIMETHYLBENZENE	0.4	100 (2)	1000 (A)	125000	170000	PSUEDOCUMENE
110	tert.BUTYLBENZENE	0.3					*(1,1-DIMETHYLETHYL)BENZENE*
111	tert.BUTYLCYCLOHEXANE	0.4					
112	1,3-DICHLOROBENZENE	0.8					
113	1-DECENE	1.3	180000 (3)	60000 (A)			n-DECYLENE
114	(CHLOROMETHYL)BENZENE	4.3					alpha-CHLOROTOLUENE; BENZYL CHLORIDE
115	1,5-DICHLOROPENTANE	0.3					
116	isoBUTYLBENZENE	0.3					
117	DECANE	0.5					*n-DECANE*
118	sec.BUTYLBENZENE	0.2					*(1-METHYLPROPYL)BENZENE*
119	3-(CHLOROMETHYL)HEPTANE	0.3					
120	1,2,3-TRIMETHYLBENZENE	0.4			125000	175000	HEMIMELLITENE
121	1ISOPROPYL4METHYLBENZENE	0.5					*METHYL(4-METHYLETHYL)BENZENE*; 3-ISOPROPYLTOLUENE; P-CYMENE
122	1,2-DICHLOROBENZENE	0.3					o-DICHLOROBENZENE
123	INDAN	0.5					*2,3-DIHYDRO-1H-INDENE*; 2,3-DIHYDROINDENE; HYDRINDENE
124	BUTYLCYCLOHEXANE	0.4					n-BUTYLCYCLOHEXANE; 1-CYCLOHEXYLBUTANE
125	1,3-DIETHYLBENZENE	0.4					m-DIETHYLBENZENE
126	1,4-DIETHYLBENZENE	0.5					p-DIETHYLBENZENE

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m³ (micrograms per cubic metre) Updated October 16, 1987

		Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names
127	BUTYLBENZENE	0.3					n-BUTYLBENZENE
128	1,2-DIETHYLBENZENE	0.5					o-DIETHYLBENZENE
129	transDECAHYDRONAPHTHALENE	0.3					t-DECALIN; BICYCLO[4,4,0]DECANE
130	cis-DECAHYDRONAPHTHALENE	0.3					c-DECALIN; BICYCLO[4,4,0]DECANE
131	UNDECANE	0.8					*n-UNDECANE*; HENDECANE
132	1235-TETRAMETHYLBENZENE	0.6					ISODURENE
133	1234-TETRAMETHYLBENZENE	0.6					PREHNITENE
134	1,3-DIISOPROPYLBENZENE	0.8					*1,3-BIS(1-METHYLETHYL)BENZENE*
135	1234TETRAHYDRONAPHTHALENE	0.6					TETRALIN
136	1,4-DIISOPROPYLBENZENE	0.8					*1,4-BIS(1-METHYLETHYL)BENZENE*; ISOPROPYLCUMENE
137	NAPHTHALENE	0.8	36 (3)	22.5 (A)			
138	DODECANE	1.3					*n-DODECANE*

Table 2 ctd.

Characteristics of the Organics Measured by the Gas Chromatographic Systems of MAMU #1

All concentrations are in terms of ug/m^3 (micrograms per cubic metre) Updated October 16, 1987

Detection Limits	Standards, Guidelines or Provisional Guidelines	Criterion	TWA	STEL	Alternate Names

NOTES: (1) Standard
(2) Guideline
(3) Provisional Guideline
(4) Standard for the sum of o-, m-, & p- Xylenes

(A) Ambient Air Quality Criterion based on a 24-hour average concentration
(B) Ambient Air Quality Criterion based on a 1-hour average concentration
(please note; if the maximum 1-hour average concentration of a contaminant is LESS than the Criterion concentration based on a 24-hour average, then that Criterion has NOT been exceeded.)

TWA - Time Weighted Average for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed without adverse effect.

STEL - Short Term Exposure Limit - concentration to which workers can be exposed for a short period of time (15 minutes) without adverse effect.

* - Denotes name approved by the International Union of Pure and Applied Chemistry (IUPAC).

Table 2 ctd.

Characteristics of the Common Contaminants as Measured Continuously by MAMU #1 and MAMU #2

All concentrations are in terms of ppm (parts per million)

	Detection Limits	Standards, Guidelines or Provisional Guidelines (1/2 hr)	Criterion (1 hr)	TWA	STEL		Alternate Names	
1 SULPHUR DIOXIDE	0.005	0.300	0.25	2	5		SO2	SULFUR DIOXIDE
2 TOTAL REDUCED SULPHUR	0.005	0.027 *	0.027	10	15	**	TRS	
3 NITROGEN OXIDES	0.01	0.25 ***	N/A	-	-		NOx	OXIDES of NITROGEN
4 NITROGEN DIOXIDE	0.01	N/A	0.20	5	5		NO2	
5 NITRIC OXIDE	0.01	N/A	N/A	25	35		NO	NITROGEN MONOXIDE
6 OZONE	0.01	0.1	0.08	0.1	0.3		O3	
7 CARBON MONOXIDE	0.1	5.0	30.0	50	400		CO	

* As equivalent H2S and applicable only for Kraft Pulp Mills
TRS may contain any of the following: Hydrogen Sulphide (H2S), Methyl Mercaptan (CH3SH), Dimethyl Sulphide (C2H6S) and Dimethyl Disulphide (C2H6S2).

** The TWA and STEL for TRS is expressed solely for Hydrogen Sulphide concentrations

*** Expressed as NO2

Table 3

Oakville 1987 Air Quality Survey

Monitoring Periods and Site Information - MAMU#1

Monitoring Period *	Start Monitoring (hr/dd/mm)	Duration (hrs)	End Monitoring (hr/dd/mm)	Site Location	# GC Runs	Comments
A173	15:31/17/08	1.4	16:55/17/08	Sherwood Park	-	Upwind
A174	17:10/17/08	20.1	13:15/18/08	Burloak/Rebecca	-	Overnight
A182	14:30/18/08	2.8	17:17/18/08	Sherwood Forest	2	Upwind
A183	18:26/18/08	18.8	13:11/19/08	S. Service Rd.	1	Overnight
A192	14:20/19/08	2.8	17:08/19/08	Rebecca & Miss.	3	Downwind
A193	17:25/19/08	19.5	13:05/20/08	Rebecca & Burl.	1	Overnight
A202	14:30/20/08	1.4	15:54/20/08	Rebecca & Burl.	2	Air Qual.
A203	16:59/20/08	2.1	19:07/20/08	P.C. Skidpad	2	Air Qual.
A204	19:31/20/08	13.4	08:56/21/08	St. Dom. School	-	Overnight
A212	10:22/21/08	2.2	12:53/21/08	P.C. Skidpad	2	Upwind
A242	13:28/24/08	3.8	17:17/24/08	Rebecca & Miss.	3	Downwind
A243	17:33/24/08	19.4	12:58/25/08	Rebecca & Burl.	-	Overnight
A252	15:02/25/08	4.2	19:17/25/08	Bronte & Wyatt	3	Downwind
A254	19:54/25/08	17.4	13:19/26/08	S. Service Rd.	1	Overnight
A262	14:41/26/08	1.3	15:59/26/08	S. Service Rd.	1	Upwind
A263	16:20/26/08	3.6	19:54/26/08	Burloak W of PC	3	Downwind
A264	20:22/26/08	16.3	12:42/27/08	S. Service Rd.	-	Overnight
A272	14:13/27/08	2.4	16:34/27/08	Burl. & Sherwood	1	Downwind
A273	17:11/27/08	16.2	09:22/28/08	S. Service Rd.	2	Overnight
A282	10:43/28/08	2.4	13:07/28/08	Burl. & Sherwood	2	Downwind
A312	12:46/31/09	23.4	12:11/01/09	Rebecca & Burl.	-	Overnight
A012	13:51/01/09	5.0	18:53/01/09	S. Service Rd.	4	Upwind
A013	19:32/01/09	16.5	12:02/02/09	Rebecca & Burl.	-	Overnight
A022	13:26/02/09	1.2	14:38/02/09	Rebecca & Burl.	1	Upwind
A023	15:13/02/09	3.5	18:41/02/09	P.C. Skidpad	3	Downwind
A025	19:23/02/09	12.7	08:03/03/09	Rebecca & Burl.	-	Overnight
A032	09:04/03/09	1.7	10:43/03/09	Rebecca & Burl.	1	Downwind
A033	11:08/03/09	4.4	15:30/03/09	S. Service Rd.	2	Downwind
A034	15:53/03/09	16.9	08:48/04/09	Rebecca & Burl.	-	Overnight
(29)	(46.2 + 210.6 = 256.8)				(40)	

* In the designation of Monitoring Periods: 'A' refers to Mobile Air Monitoring Unit #1 (MAMU#1) and 'B' for MAMU#2; the next two digits, the day of the month; and the final digit, the data acquisition episode of the day.

Table 3 ctd.

Oakville 1987 Air Quality Survey

Monitoring Periods and Site Information - MAMU#2

Monitoring Period *	Start Monitoring (hr/dd/mm)	Duration (hrs)	End Monitoring (hr/dd/mm)	Site Location	# GC Runs	Comments
B173	15:48/17/08	1.1	16:56/17/08	Sherwood Forest	3	Upwind
B174	17:28/17/08	19.2	12:33/18/08	St. Dom. School	-	Overnight
B182	15:17/18/08	2.3	17:32/18/08	Sherwood Forest	2	Upwind
B183	18:26/18/08	18.1	12:31/19/08	St. Dom. School	2	Overnight
B192	13:39/19/08	0.6	14:16/19/08	St. Dom. School	1	Downwind
B193	15:17/19/08	2.5	17:48/19/08	P.C. Skidpad	2	Downwind
B194	18:08/19/08	18.3	12:28/20/08	Bronte & Speers	1	Overnight
B202	14:28/20/08	2.1	16:35/20/08	P.C. Skidpad	2	Downwind
B203	17:18/20/08	2.4	19:41/20/08	Rebecca & Burl.	2	Air Qual.
B204	19:47/20/08	13.2	08:57/21/08	Rebecca & Burl.	-	Overnight
B212	10:21/21/08	3.0	13:21/21/08	S. McPherson Rd.	3	Downwind
B242	13:22/24/08	3.6	17:00/24/08	Heavy Fuel Gate	3	Downwind
B243	17:41/24/08	19.1	12:46/25/08	St. Dom. School	-	Overnight
B252	13:39/25/08	0.7	14:23/25/08	St. Dom. School	-	Downwind
B253	14:58/25/08	2.8	17:46/25/08	St. Dom. School	2	Downwind
B254	17:57/25/08	2.4	20:21/25/08	St. Dom. School	2	Downwind
B255	20:25/25/08	16.5	12:55/26/08	St. Dom. School	-	Overnight
B262	14:47/26/08	1.5	16:19/26/08	St. Dom. School	1	Upwind
B263	16:45/26/08	3.0	19:46/26/08	P.C. Skid Pad	3	Upwind
B265	20:17/26/08	16.6	12:52/27/08	St. Dom. School	-	Overnight
B274	15:18/27/08	1.9	17:10/27/08	Burl. N P.W.Dr.	2	Downwind
B275	17:58/27/08	0.6	18:32/27/08	Rebecca & Burl.	1	Upwind
B276	18:35/27/08	14.8	09:25/28/08	Rebecca & Burl.	-	Overnight
B312	14:01/31/08	22.5	12:31/01/09	Bronte & Speers	-	Overnight
B012	14:14/01/09	4.9	19:05/01/09	Rebecca & Miss.	2	Downwind
B013	20:08/01/09	16.1	12:13/02/09	Bronte & Speers	-	Overnight
B022	14:34/02/09	2.0	16:31/02/09	Bronte & Speers	-	Air Qual.
B023	17:36/02/09	1.3	18:54/02/09	Shelbourne St.	1	Upwind
B024	19:19/02/09	12.9	08:14/03/09	Bronte & Speers	-	Overnight
B032	09:28/03/09	1.4	10:51/03/09	Bronte & Speers	-	Upwind
B033	11:40/03/09	1.8	13:29/03/09	Harbourside Dr.	1	Upwind
B034	13:33/03/09	2.7	16:13/03/09	Harbourside Dr.	1	Upwind
B035	16:28/03/09	17.1	09:33/04/09	Bronte & Speers	-	Overnight

Table 4

Oakville 1987 Air Quality Survey

Monitoring Summary

UPWIND				DOWNWIND				GENERAL AIR QUALITY			
Monitoring Period	Start Time		(#GC Runs) & MP Duration	Monitoring Period	Start Time		(#GC Runs) & MP Duration	Monitoring Period	Start Time		(#GC Runs) & MP Duration
A173	15:31		1.4	A192	14:20		(3) 2.8	A174	17:10		20.1
B173	15:48		(3) 1.1	B192	13:39		(1) 0.6	B174	17:28		19.2
A182	14:30	c	(2) 2.8	B193	15:17		(2) 2.5	A183	18:26		(1) 18.8
B182	15:17	c	(2) 2.3	B202	14:28		(2) 2.1	B183	18:26	*	(2) 18.1
A212	10:22		(2) 2.2	B212	10:21		(3) 3.0	A193	17:25		(1) 19.5
A262	14:41		(1) 1.3	A242	13:28	c	(3) 3.8	B194	18:08	*	(1) 18.3
B262	14:47		(1) 1.5	B242	13:22	c	(3) 3.6	A202	14:30		(2) 1.4
B263	16:45		(3) 3.0	B252	13:39		0.7	A203	16:59	c	(2) 2.1
B275	17:58		(1) 0.6	B253	14:58		(2) 2.8	B203	17:18	c	(2) 2.4
A012	13:51		(4) 5.0	A252	15:02		(3) 4.2	A204	19:31	*	13.4
A022	13:26		(1) 1.2	B254	17:57		(2) 2.4	B204	19:47		13.2
B023	17:36		(1) 1.3	A263	16:20		(3) 3.6	A243	17:33		19.4
B032	09:28		1.4	A272	14:13		(1) 2.4	B243	17:41		19.1
B033	11:40		(1) 1.8	B274	15:18		(2) 1.9	A254	19:54		(1) 17.4
B034	13:33		(1) 2.7	A282	10:43		(2) 2.4	B255	20:25		16.5
				B282	10:48		(2) 2.3	A264	20:22		16.3
				B012	14:14		(2) 4.9	B265	20:17		16.6
				A023	15:13		(3) 3.5	A273	17:11		(2) 16.2
				A032	09:04		(1) 1.7	B276	18:35		14.8
				A033	11:08		(2) 4.4	A312	12:46	*	23.4
								B312	14:01		22.5
								A013	19:32		16.5
								B013	20.08	*	16.1
								A025	19:23		12.7
								B022	14:34		2.0
								B024	19:19		12.9
								A034	15:53		16.9
								B035	16:28		17.1

TOTALS:

15 MPs	(23) & 29.6	20 MPs	(42) & 55.6	28 MPs	(14) & 422.9

Notes:
- Duration in Hours
- c Comparison GC Runs
- * Downwind and Overnight Monitoring
- # Number
- GC Gas Chromatograph
- MP(s) Monitoring Period(s)

Table 5

Common Contaminants - Oakville 1987 Air Quality Survey - MAMU#1

Overall Average Ground Level Concentrations (ppm)

Monitoring Period	Start Time	Duration (hrs)	CO	TH-M	TRS	NO2	Average Wind *
A173	17/15:31	1.4	3.2	0.37	0.003	0.02	2738
A174	17/17:10	20.1	0.2	0.06	nd.	0.02	****
A182	18/14:30	2.8	0.4	1.29	0.012	0.01	2819
A183	18/18:26	18.8	1.0	0.76	nd.	0.05	****
A192	19/14:20	2.8	0.6	0.99	0.004	0.02	2925
A193	19/17:25	19.5	0.2	0.15	nd.	0.03	****
A202	20/14:30	1.4	0.3	0.89	nd.	0.01	3121
A203	20/16:59	2.1	0.8	1.46	nd.	0.01	3010
A204	20/19:31	13.4	0.6	1.02	nd.	0.05	****
A212	21/10:22	2.2	0.5	1.44	nd.	0.02	1210
A242	24/13:28	3.8	0.4	0.94	0.003	0.01	2923
A243	24/17:33	19.4	0.4	0.61	nd.	0.03	****
A252	25/15:02	4.2	0.4	1.06	nd.	0.02	2614
A254	25/19:54	17.4	0.7	1.19	nd.	0.03	****
A262	26/14:41	1.3	0.4	0.47	nd.	0.01	0522
A263	26/16:20	3.6	0.7	0.88	0.002	0.02	0519
A264	26/20:22	16.3	0.5	0.47	nd.	0.02	****
A272	27/14:13	2.4	0.5	0.70	0.005	0.04	0921
A273	27/17:11	16.2	0.9	0.48	0.002	0.02	****
A282	28/10:43	2.4	0.5	0.54	0.007	0.03	0831
A312	31/12:46	23.4	0.2	0.09	nd.	0.03	****
A012	01/13:51	5.0	0.9	0.38	nd.	0.07	2926
A013	01/19:32	16.5	0.5	0.44	nd.	0.04	****
A022	02/13:26	1.2	0.3	0.53	nd.	0.01	1414
A023	02/15:13	3.5	0.7	0.77	nd.	0.02	????
A025	02/19:23	12.7	0.4	0.83	nd.	0.03	****
A032	03/09:04	1.7	0.5	0.58	SO2	0.03	0606
A033	03/11:08	4.4	1.1	1.05	SO2	0.02	1416
A034	03/17:53	16.9	0.6	0.83	SO2	0.02	****

nd. - not detected; concentration in ambient air less than detection limit of analyzer. The detection limit for the TRS analyzer was 0.002 ppm.

* - the first two digits refer to the direction (in tens of degrees) from which the wind was blowing and the last two digits refer to the speed in km/hr.

**** - overnight monitoring; average wind not applicable

Monitoring Period - the 'A' refers to Mobile Air Monitoring Unit #1; the next two digits, the day of the month; and the last digit, the monitoring episode of the day.

Table 5 ctd.

Common Contaminants - Oakville 1987 Air Quality Survey - MAMU#1

Maximum One-Hour Average Ground Level Concentrations (ppm)

Monitoring Period	CO	TH-M	TRS	NO2	Wind at time of Maximum *
A174	0.5	0.20	nd.	0.04	3528
A183	2.0	0.97	0.003	0.07	3621
A193	0.5	0.86	nd.	0.05	3533
A204	1.3	2.29	nd.	0.06	3602
A243	1.0	0.90	0.002	0.05	3026
A254	2.3	1.63	0.005	0.05	3629
A264	1.7	0.86	0.004	0.04	1240
A273	2.2	0.98	0.004	0.04	1417
A312	0.6	0.44	nd.	0.04	3537
A013	1.1	0.81	nd.	0.05	3610
A025	1.0	1.26	0.002	0.04	3620
A034	1.2	1.40	SO2	0.04	3511

Maximum ½-Hour Average Ground Level Concentrations (ppm)

Monitoring Period	CO	TH-M	TRS	NO2	Wind at time of Maximum *
A173	5.5	0.42	0.004	0.02	2840
A182	0.6	1.51	nd.	0.01	3023
A192	2.1	1.36	0.016	0.02	3129
A202	0.3	0.95	nd.	nd.	3523
A203	1.1	1.71	nd.	0.02	3112
A212	0.7	1.56	0.002	0.05	1613
A242	0.6	1.30	0.004	0.01	3026
A252	0.4	1.35	nd.	0.03	2818
A262	0.4	0.62	nd.	0.02	0624
A263	1.9	1.11	0.006	0.03	2025
A272	0.6	1.11	0.010	0.04	1228
A282	0.5	0.69	0.009	0.04	0935
A012	1.2	0.46	0.002	0.08	3037
A022	0.3	0.54	nd.	0.01	1516
A023	2.2	1.05	0.002	0.03	3617
A032	0.7	0.72	SO2	0.03	1313
A033	7.0	5.57	SO2	0.03	1619

Table 6

Common Contaminants - Oakville 1987 Air Quality Survey - MAMU#2

Overall Average Ground Level Concentrations (ppm)

Monitoring Period	Start Time	Duration (hrs)	CO	TH-M	TRS	NO2	Average Wind *
B173	17/15:48	1.1	1.1	0.44	nd.	0.02	2425
B174	17/17:28	19.2	1.0	1.06	nd.	0.02	****
B182	18/15:17	2.3	0.7	0.49	nd.	0.03	2412
B183	18/18:26	18.1	0.2	0.41	nd.	0.02	****
B192	19/13:39	0.6	0.2	0.34	0.003	0.04	2217
B193	19/15:17	2.5	0.7	0.41	nd.	0.04	2714
B194	19/18:08	18.3	0.7	0.23	nd.	0.04	****
B202	20/14:28	2.1	0.7	0.41	nd.	0.02	2809
B203	20/17:18	2.4	nd.	na.	nd.	0.02	2712
B204	20/19:47	13.2	0.7	0.40	0.003	0.04	****
B212	21/10:21	3.0	0.2	0.97	nd.	0.03	1909
B242	24/13:22	3.6	0.8	0.55	0.002	0.02	2617
B243	24/17:41	19.1	0.4	0.94	0.004	0.03	****
B252	25/13:39	0.7	0.2	0.30	nd.	0.02	2413
B253	25/14:58	2.8	0.2	0.48	nd.	0.02	2316
B254	25/17:57	2.4	0.2	0.57	0.003	0.02	2511
B255	25/20:25	16.5	0.3	0.85	0.003	0.04	****
B262	26/14:47	1.5	0.2	0.13	nd.	0.01	0310
B263	26/16:45	3.0	0.4	0.33	nd.	0.02	0111
B265	26/20:17	16.6	0.3	0.16	nd.	0.02	****
B274	27/15:18	1.9	0.3	0.30	nd.	0.02	0715
B275	27/17:58	0.6	0.4	0.30	nd.	0.03	1004
B276	27/18:35	14.8	0.5	0.49	0.002	0.03	****
B312	31/14:01	22.5	1.1	1.38	nd.	0.04	****
B012	01/14:14	4.9	1.2	0.32	0.002	0.02	2811
B013	01/20:08	16.1	1.2	0.99	nd.	0.03	****
B022	02/14:34	2.0	0.4	0.22	nd.	0.02	1109
B023	02/17:36	1.3	0.6	0.34	nd.	0.01	0802
B024	02/19:19	12.9	0.4	0.67	nd.	0.03	****
B032	03/09:28	1.4	0.5	0.41	nd.	0.03	0105
B033	03/11:40	1.8	0.7	0.51	nd.	0.03	1603
B034	03/13:33	2.7	0.7	0.57	nd.	nd.	1800
B035	03/16:28	17.1	1.0	0.53	nd.	0.04	****

nd. - not detected; concentration in ambient air less than detection limit of the analyzer.
na. - not available.
* - the first two digits refer to the direction (in tens of degrees) from which the wind was blowing and the last two digits refer to the speed in km/hr.
**** - overnight monitoring; average wind not applicable
Monitoring Period - the 'B' refers to Mobile Air Monitoring Unit #2; the next two digits, the day of the month; and the last digit, the monitoring episode of the day.

Table 6 ctd.

Common Contaminants - Oakville 1987 Air Quality Survey - MANU#2

Maximum One-Hour Average Ground Level Concentrations (ppm)

Monitoring Period	CO	TH-M	TRS	NO2	Wind at time of Maximum *
B174	1.0	4.04	nd.	0.04	0703
B183	0.5	1.05	nd.	0.04	2814
B194	2.7	1.76	0.002	0.05	3016
B204	2.8	1.30	0.005	0.05	3504
B243	0.6	4.96	0.006	0.05	2303
B255	0.8	2.16	0.003	0.07	3412
B265	0.9	0.92	0.003	0.06	0919
B276	0.9	0.70	0.003	0.05	3610
B312	3.0	7.21	0.003	0.06	3120
B013	4.3	3.70	nd.	0.05	2402
B024	1.3	2.53	nd.	0.05	3411
B035	2.0	1.11	nd.	0.06	3507

Maximum ½-Hour Average Ground Level Concentrations (ppm)

Monitoring Period	CO	TH-M	TRS	NO2	Wind at time of Maximum *
B173	1.2	0.47	nd.	0.02	2525
B182	1.4	0.59	nd.	0.03	2615
B192	0.2	0.35	0.004	0.04	2317
B193	0.9	0.80	0.003	0.04	2916
B202	0.9	0.70	0.002	0.03	3010
B203	0.2	na.	0.003	0.03	2813
B212	0.2	1.41	nd.	0.04	2014
B242	0.9	0.69	0.003	0.03	2819
B252	0.2	0.34	nd.	0.02	2513
B253	0.2	0.52	nd.	0.02	2518
B254	0.3	0.74	0.003	0.03	2616
B262	0.2	0.14	0.002	0.01	0410
B263	1.0	0.56	0.003	0.03	0513
B274	0.5	0.36	0.003	0.02	0918
B275	0.4	0.31	nd.	0.03	1004
B012	2.9	0.50	0.004	0.02	2916
B022	0.6	0.29	nd.	0.03	1311
B023	0.6	0.39	nd.	0.02	0903
B032	0.5	0.45	nd.	0.03	3607
B033	0.9	0.70	nd.	0.03	1905
B034	1.3	0.91	nd.	0.01	2000

Table 7

The Common Contaminants - Summary

Ground Level Concentrations

Monitoring Programme	CO	TRS	SO_2	NO_2	TH-M
Downwind Measurements					
Maximum 30-minute Averages					
MAMU#1	7.0	0.016	0.04	0.04	5.6
MAMU#2	2.9	0.004	0.05	0.04	1.4
Upwind Measurements					
Maximum 30-minute Averages					
MAMU#1	5.5	0.004	na.	0.08	1.6
MAMU#2	1.4	0.003	0.01	0.03	0.6
General Air Quality					
Maximum 60-minute Averages					
MAMU#1	2.3	0.004	0.01	0.07	2.3
MAMU#2	4.3	0.006	0.03	0.07	5.0
Overall Averages					
MAMU#1	0.5	0.001*	0.005*	0.03	0.6
MAMU#2	0.6	0.002	0.01	0.03	0.6

Concentration units are ppm (parts per million by volume).
na. = not available * = ½ minimal detectable limit

Table 8

The Volatile Organic Contaminants

	Downwind		Upwind		General Air Quality	
	Average	Maximum	Average	Maximum	Average	Maximum
(Concentration Units; ug/m^3)						
Organic Compound Names						
PROPANE	25.5	162.0	4.0	9.9	33.1	207.5
2-METHYLPROPANE	10.3	80.4	6.5	55.6	11.6	50.3
CHLOROETHENE					2.0	2.0
1-BUTENE	8.2	11.6	12.2	12.2	6.7	6.7
BUTANE	21.6	163.5	18.4	119.0	21.8	146.0
CHLOROETHANE					1.8	1.8
2-METHYLBUTANE	25.5	140.0	14.5	78.0	46.4	239.0
2-METHYL-1-BUTENE	5.6	23.0	5.2	9.1	86.9	408.6
PENTANE	13.3	84.7	9.2	56.5	30.7	203.5
2-METHYL-1,3-BUTADIENE	2.2	3.5	2.9	4.3	9.2	21.2
trans-2-PENTENE	3.8	18.9	3.4	10.4	15.6	15.6
cis-2-PENTENE	3.8	8.4	2.2	3.4	4.7	5.5
DICHLOROMETHANE			4.2	4.4		
2-METHYL-2-BUTENE	4.9	20.9	4.6	13.2	13.2	19.1
2,2-DIMETHYLBUTANE	1.7	2.6	3.1	4.9	5.4	5.4
CYCLOPENTANE	2.2	5.7	4.6	11.8	6.6	8.2
2,3-DIMETHYLBUTANE	3.5	8.6	3.0	7.9	8.0	8.0
2-METHYLPENTANE	6.4	30.0	6.6	36.3	7.4	37.4
3-METHYLPENTANE	4.3	16.8	4.4	23.8	5.1	22.6
1-HEXENE	1.2	1.2				
HEXANE	5.7	22.0	6.0	34.5	6.2	30.3
TRICHLOROMETHANE			10.8	10.8		
METHYLCYCLOPENTANE	3.4	9.7	2.9	8.8	3.6	8.8
2,4-DIMETHYLPENTANE	2.3	3.4	2.1	4.0	2.8	2.8
1,1,1-TRICHLOROETHANE			4.7	6.2		
BENZENE	24.8	233.8	14.1	62.9	3.9	12.0
TETRACHLOROMETHANE			19.3	26.1	18.4	18.4
3,3-DIMETHYLPENTANE					1.1	1.1
CYCLOHEXANE	2.3	4.9	1.7	2.0	2.1	2.1
2,3-DIMETHYLPENTANE	1.9	2.9	2.8	5.5	3.3	3.3
2-METHYLHEXANE	2.6	7.8	3.0	9.5	2.9	6.7
3-METHYLHEXANE	2.3	5.6	3.6	10.7	3.2	7.3
TRICHLOROETHENE			5.5	6.5		
2,2,4-TRIMETHYLPENTANE	2.7	8.0	2.3	7.8	2.4	4.5
1-HEPTENE	1.9	3.7				
HEPTANE	2.3	6.1	2.8	10.6	1.9	4.7
METHYLCYCLOHEXANE	2.7	7.2	5.2	22.6	1.5	1.5

Table 8

The Volatile Organic Contaminants

	Downwind		Upwind		General Air Quality	
	Average	Maximum	Average	Maximum	Average	Maximum
(Concentration Units; ug/m^3)						
Organic Compound Names						
2,3,4-TRIMETHYLPENTANE	2.2	4.5				
TOLUENE	5.7	16.1	10.0	21.4	5.0	13.7
2-METHYLHEPTANE	1.5	2.1	2.8	6.2	1.4	1.4
c-1,3-DIMETHYLCYCLOHEXANE	1.4	1.8				
3-METHYLHEPTANE	1.8	2.4				
OCTANE	1.6	2.5	2.0	2.2	1.2	1.2
ETHYLBENZENE	1.5	2.5	2.4	5.9	1.1	1.2
M,P-XYLENE	3.3	8.2	5.5	21.8	2.8	4.1
o-XYLENE	1.6	2.4	2.0	5.1	1.3	1.7
NONANE	1.9	5.2	2.8	4.6	1.0	1.0
3-ETHYLTOLUENE	1.3	1.7	1.7	3.6	1.2	1.6
1,3,5-TRIMETHYLBENZENE	2.5	8.1	2.6	6.1		
2-ETHYLTOOLUENE			1.2	1.3		
tert.BUTYLBENZENE			5.0	6.4		
1,2,4-TRIMETHYLBENZENE	1.6	2.5	3.7	10.8	2.4	3.0
DECANE	1.9	5.2	3.8	9.1	1.9	2.0
1,2,3-TRIMETHYLBENZENE			2.0	2.2		
BUTYLBENZENE	3.1	4.5				
UNDECANE	2.5	12.9	4.9	16.8	1.3	1.7
1235-TETRAMETHYLBENZENE			1.7	2.3		
DODECANE	2.3	8.2	4.9	26.4	2.0	3.7
Total Number of Different Organics Detected	46		49		43	
Total Organic Conc.	156	706	119	476	195	924
Alkanes	113	602	76	385	143	565
Cycloalkanes	4	21	4	29	2	21
Alkenes	6	88	5	40	37	441
Cycloalkenes	0	0	0	0	0	0
Alkynes	0	0	0	0	0	0
Aromatics	33	238	31	85	11	30
Chlorinated Alkanes	0	0	3	37	1	18
Chlorinated Alkenes	0	0	0	6	0	2
Chlorinated Aromatics	0	0	0	0	0	0